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TRAFFIC DIVERSION TO TOLL ROADS

by John T. Lynch, A.M. ASCE

HIGHWAY DIVISION

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TRAFFIC DIVERSION TO TOLL ROADS

John T. Lynch,¹ A.M., ASCE

The Bureau of Public Roads has for a number of years been engaged in a study of toll-road traffic with the cooperation of the State highway departments and the toll road Authorities. We have been supplied regularly with detailed information concerning the traffic using the various turnpikes and we receive each month, from the State highway departments, traffic counts at numerous points on other roads as a part of our regular cooperative highway planning survey program. In addition, more comprehensive traffic studies have been made for several of the turnpikes both before and after construction.

This paper will be somewhat broader than the title "Traffic Diversion to Toll Roads" as it will include a discussion of traffic diversion, generation, and growth. The three are closely inter-related and it is generally difficult to distinguish one from another.

When a high type facility, such as a toll road, is constructed there is a large diversion of traffic from roads immediately parallel and a lesser diversion from more distant roads. In addition, there is an increase in traffic throughout the area which we call traffic generation. Some of this traffic which we call generated is really diverted from public carriers, but an important part of it is composed of new trips which would not have been made if the high type facility had not been available. We find that this generation does not occur in its entirety the first year after the new road is open but that it appears rather as a greater than normal growth over the first few years of the operation of the facility. After that the growth may more nearly parallel the general growth of traffic in the area.

The Maine Turnpike offers a good opportunity to study traffic generation and growth because there is only one road through the area which closely parallels the turnpike and, in this case, very little of the turnpike traffic could be diverted from other more distant roads.

Fig. 1 shows the trend in traffic on U.S. 1 and the Maine Turnpike from 1947 (the last year before the turnpike was opened) through 1953 compared to the trend on other important roads throughout the State. The traffic counts on U.S. 1 used in this comparison were taken near the middle of the turnpike area where the volume is lowest in order to eliminate as much as possible the effect of local trips which could not conveniently use the turnpike. If the count had been made near Portland at the north end of the turnpike there would have been a large amount of local travel which would cloud the picture considerably.

In the figure, the 1947 traffic is taken as 100 percent. The line sloping upward on the chart represents the trend of traffic for other important roads throughout the State of Maine. It might be presumed that U.S. 1 traffic would have increased at something like this rate, if the turnpike had not been built.

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MAINE TURNPIKE TRAFFIC STUDY RELATION OF TRAFFIC ON TURNPIKE TO THAT ON U S 1 AT MILE 29, BY YEARS

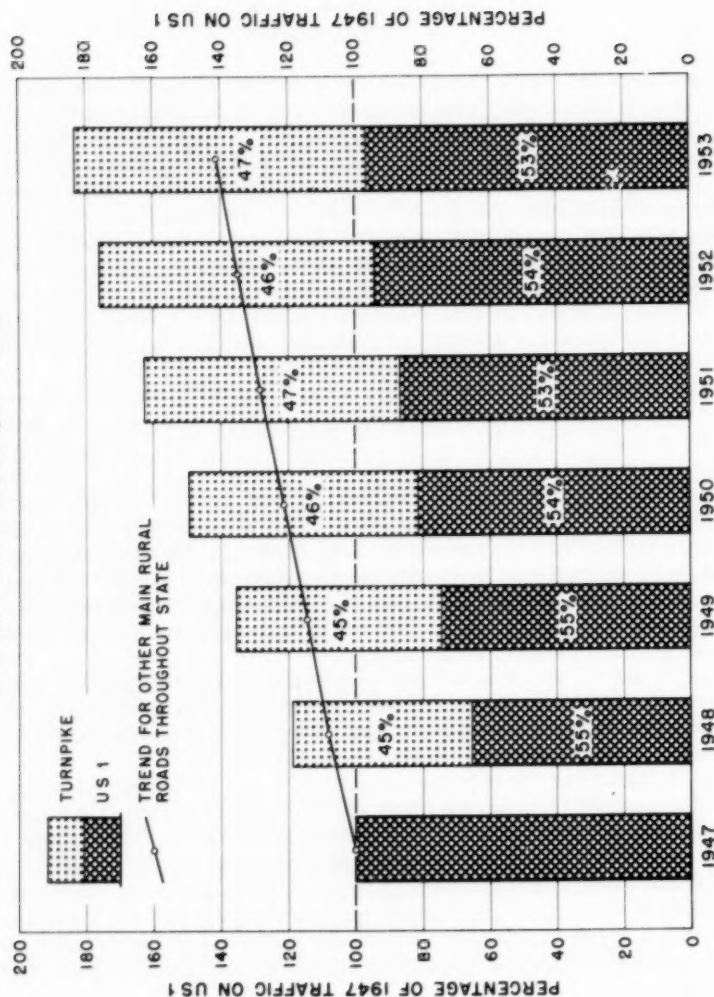


FIGURE 1

The turnpike was opened in December 1947 and during the succeeding years shown on the chart, the traffic through the corridor (that is on both the turnpike and U.S. 1) continued to increase more rapidly than traffic on other important roads in the State and it, therefore, appears that there was continuing generation throughout this period.

The figures within the bars indicate the percentage distribution of the corridor traffic between the turnpike and U.S. 1. In 1948, 45 percent of the corridor traffic was on the turnpike, shown in the upper portion of the bar, and 55 percent was on U.S. 1, shown in the lower portion. This relative distribution remained reasonably constant throughout the period. In 1953, 47 percent of the traffic was on the turnpike and 53 percent on U.S. 1. This slight increase in the turnpike percentage use occurred in spite of the fact that passenger car toll rates were increased from 50 to 60 cents for full length trips of about 45 miles in May 1949, and again from 60 to 75 cents in May 1952. In 1953, U.S. 1 traffic was only 3 percent lower than the year before the turnpike was opened and it is apparent that U.S. 1 will soon again become as congested as it was in 1947. When this occurs, it may well be that a higher percentage of the traffic will be diverted to the turnpike. This depends, of course, upon what steps are taken to improve U.S. 1.

In making studies to determine the amount of traffic which can be expected to use a proposed toll road, a common procedure is as follows:

- 1) Estimate the amount of the existing traffic on routes paralleling the toll road location which would be diverted to the new facility.
- 2) Increase this by a generation factor to account for the increase in travel which could be expected after a superior, high-speed route is available.
- 3) Project this traffic forward on the basis of the trend forecasted for traffic on principal roads throughout the area.

Fig. 2 is drawn to test such a procedure and to determine what generation factor should have been used in forecasting the traffic which would use the Maine Turnpike. This chart is plotted on semi-log paper which has the characteristic of presenting equal growth rates as parallel lines regardless of the elevation of the lines on the chart. The lower curve shows the trend in traffic on the principal roads throughout Maine, exclusive of the turnpike, from 1947 to 1953. The upper solid curve shows the trend on the turnpike throughout this period. In both cases, the 1947 traffic is assigned a value of 1.0 on the chart.

The turnpike was not open in 1947 and its traffic for that year was estimated on the assumption that the distribution between the turnpike and U.S. 1 would have been the same as it actually was in 1948, that is to say 45 percent on the turnpike and 55 percent on U.S. 1. In other words, it is assumed that the engineer making the study was successful in forecasting accurately the percentage distribution of traffic between U.S. 1 and the turnpike immediately after it was opened.

The sloping, broken lines above the turnpike curve are drawn from the point on that curve for each year back to the Y axis parallel to a line from the point for the same year on the curve for other main roads back to the 1947 point on that curve (1.0). These lines, therefore, show the portion of the turnpike traffic increases attributable to normal growth as measured by the trend on other important roads throughout the State, and the ordinate of the point of intersection of each line with the Y axis is the generation factor which would have had to be used to arrive at the actual turnpike traffic for each year, assuming that the normal growth trend had been accurately forecasted.

MAINE TURNPIKE TRAFFIC STUDY

GROWTH OF TRAFFIC ON TURNPIKE COMPARED TO THAT ON OTHER MAIN RURAL ROADS THROUGHOUT STATE (1947-1953)

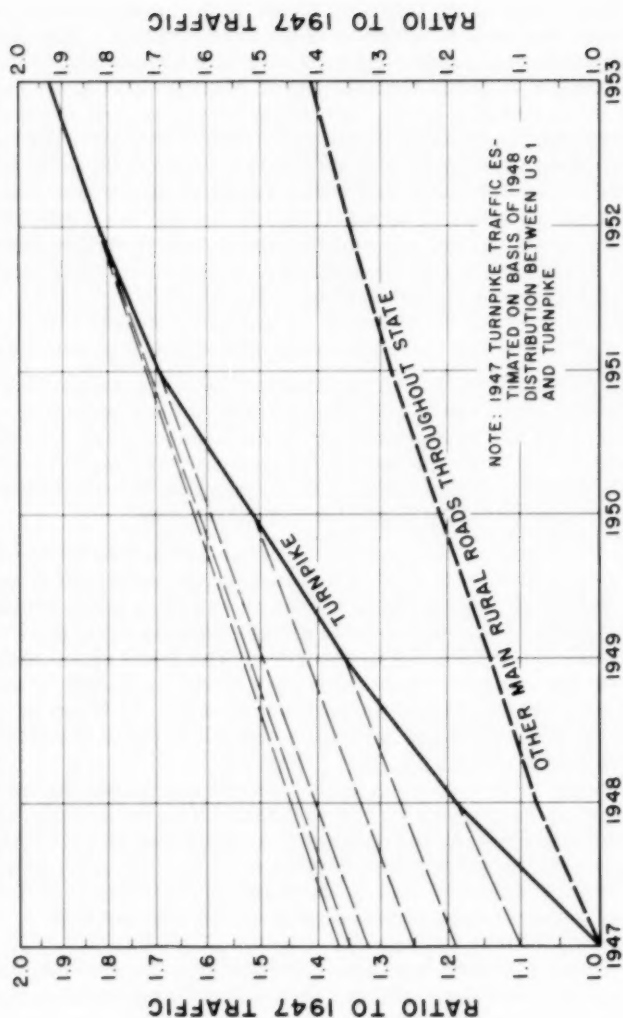


FIGURE 2

In general, these sloping lines have a wider spread toward the bottom and get quite close together toward the top, indicating that the traffic generation is largely accomplished in the earlier years. However, the space between the third and fourth line is somewhat wider than that between the second and third, and this may be due to the generating effect of the opening of the New Hampshire Turnpike which occurred in June 1950.

The ordinate on the Y axis of the top line for 1953 is 1.37. To say that this means a 37 percent generation for the period, however, would not be entirely accurate, as Fig. 1 showed a somewhat higher diversion from U.S. 1 in 1953 than in 1948. Considering the entire traffic for the corridor (U.S. 1 and the turnpike combined) the 1953 generation factor, computed in the same manner is 1.30. The difference between the 1.37 and the 1.30 factors is attributable to increased diversion to the turnpike from U.S. 1.

Fig. 3 shows the growth from 1947 to 1953 of traffic on the original section of the Pennsylvania Turnpike between Irwin and Carlisle compared with that of other rural roads in Pennsylvania during this same period. Throughout the period from 1947 to 1952 the turnpike curve has a steeper slope than the curve for the other roads indicating a more rapid growth. From 1952 to 1953 the two curves are very nearly parallel. This turnpike had been in operation for 7 years in 1947 so the more rapid growth of the turnpike traffic does not represent generation occurring soon after the opening of a new facility of this kind. We have no way of knowing whether it represents continuing generation or increasing diversion. The fact that the rate of growth of traffic on the other main rural roads throughout the State is materially lower than for other States in the vicinity suggests that increasing diversion may be an important factor. The very steep slope in the turnpike curve from 1950 to 1952 undoubtedly shows the effect of the opening of the eastern and western extensions of the turnpike. The former was opened in November 1950 and the latter partly in August and partly in October 1951. This is a good illustration of the effect of turnpike extensions and connections on traffic on the old section. However, in considering this, we should also consider that as the turnpike network is extended, there may also be competition between parallel routes even though at a considerable distance apart, which would have the opposite effect.

Fig. 4 shows the growth of traffic on the old section of the Pennsylvania Turnpike compared to that on other important rural roads in Pennsylvania throughout the life of the turnpike. During the war years, traffic on the turnpike decreased much more rapidly than that on the other roads, but after 1943, the last full year of the war, it made a rapid recovery and in 1953 it was 187 percent higher than in 1941, whereas traffic on other principal roads in Pennsylvania was only 24 percent higher than in 1941. Of course, the traffic increase on the other roads would have been higher, if it had not been for diversion to the turnpike, but still far below the turnpike increase. This phenomenal growth of the Pennsylvania Turnpike traffic is probably due to unique features of this particular project and we would certainly be unwise to assume that it would be duplicated on other projects.

We saw from Fig. 1 that the annual percentage distribution of traffic between the Maine Turnpike and U.S. 1 has remained fairly constant since the first year of its opening. The question arises as to whether it is constant throughout the year or varies with the season.

Fig. 5 shows the variation in the percentage of the corridor traffic carried by the Maine Turnpike in the different seasons, averaged for the six years of turnpike operation from 1948 to 1953. The widths of the bars are

PENNSYLVANIA TURNPIKE TRAFFIC STUDY

GROWTH OF TRAFFIC ON TURNPIKE (IRWIN-CARLISLE) COMPARED TO
THAT ON OTHER MAIN RURAL ROADS THROUGHOUT STATE (1947-1953)

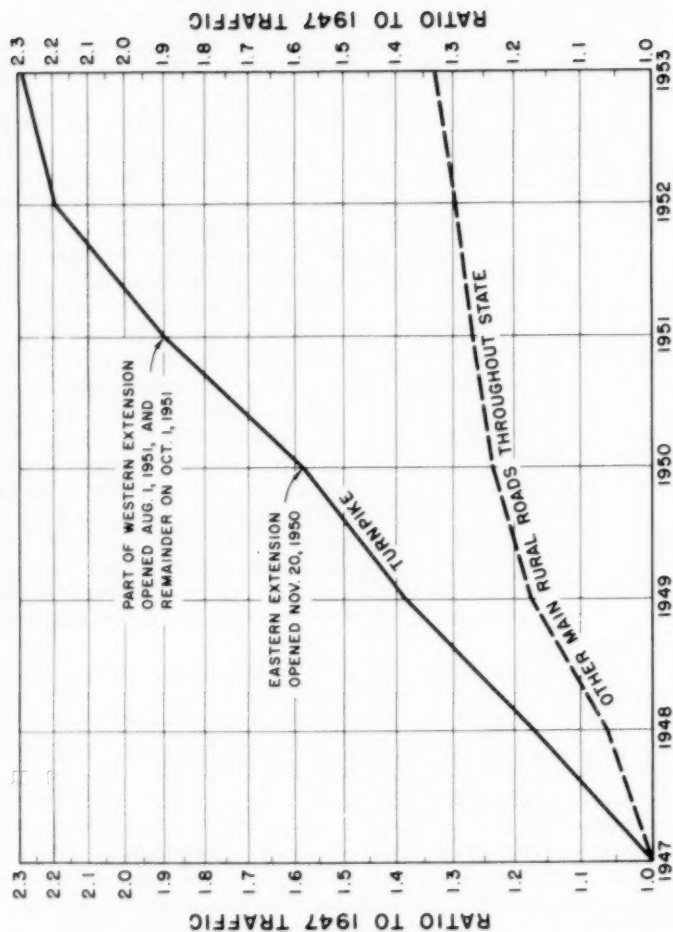


FIGURE 3

PENNSYLVANIA TURNPIKE TRAFFIC STUDY GROWTH OF TRAFFIC ON TURNPIKE (IRWIN-CARLISLE) COMPARED TO THAT ON OTHER MAIN RURAL ROADS THROUGHOUT STATE (1941-1953)

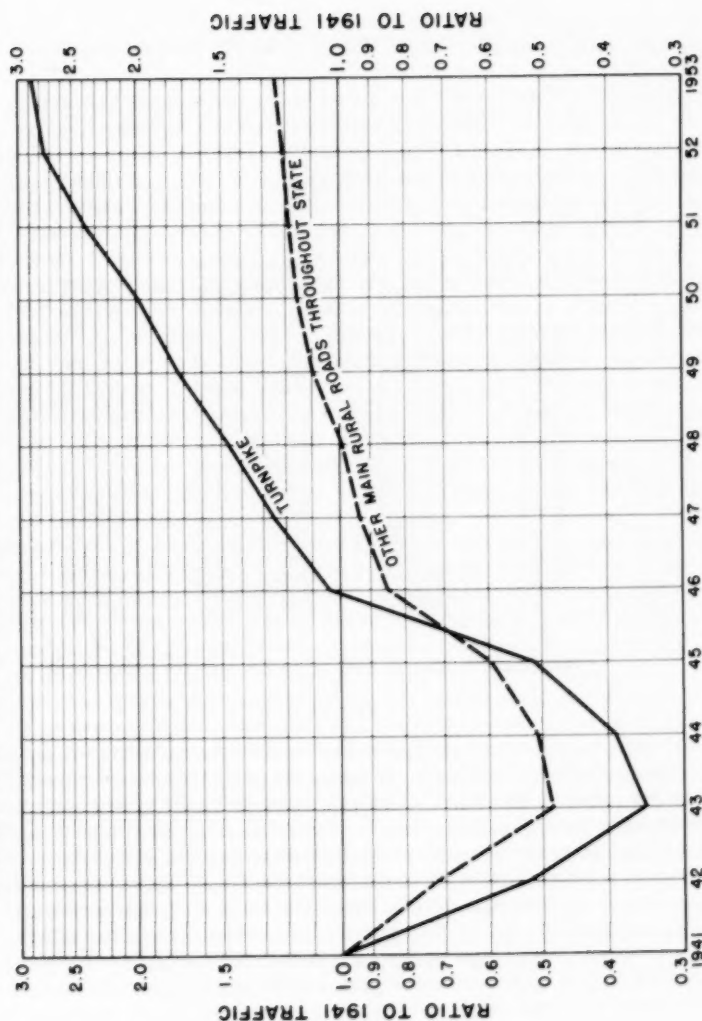


FIGURE 4

MAINE TURNPIKE TRAFFIC STUDY

PERCENTAGE OF CORRIDOR TRAFFIC USING TURNPIKE AT MILE 29 IN EACH SEASON

SIX-YEAR AVERAGE (1948-1953)

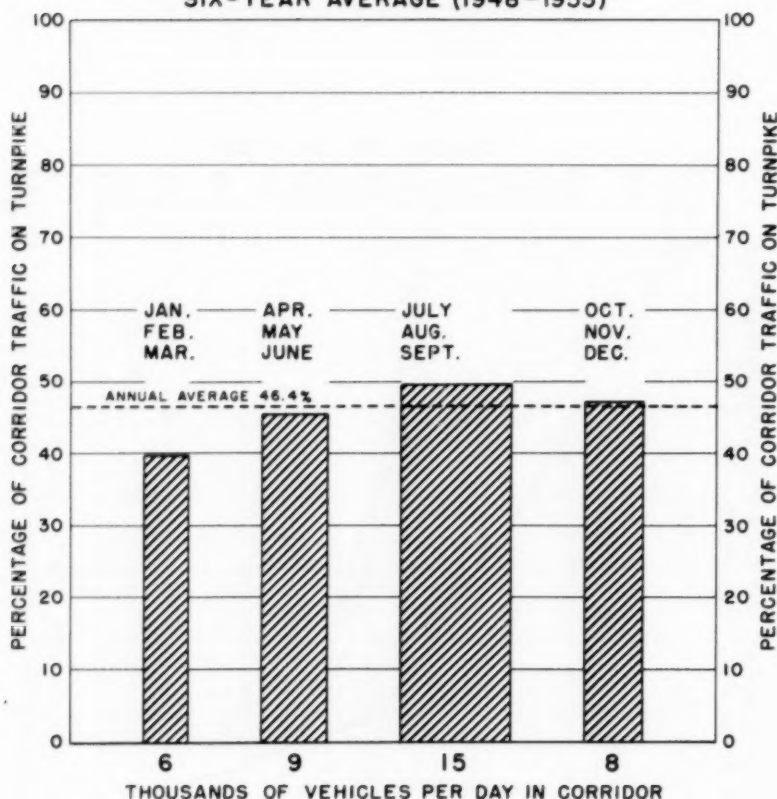


FIGURE 5

proportional to the volumes of corridor traffic in the different seasons. In the winter season, when traffic is light, the proportionate usage of the turnpike is less than in the other seasons; whereas in July, August, and September with very heavy traffic volumes, the proportionate usage is highest. This is of special interest because most studies are made in the summer months and it is important to be able to estimate the extent to which conditions with respect to turnpike usage prevailing at that time are representative of conditions throughout the year. The horizontal broken line on the chart shows the annual average percentage of the corridor traffic using the turnpike. It will be noted that this is only about 3 percent below the peak usage in July, August, and September. The lower percentage use in January, February, and March does not affect the average annual percentage greatly because of the low volumes during that period. A similar relation between the proportionate turnpike usage in the different seasons was found for the eastern extension of the Pennsylvania Turnpike, though the seasonal variations in traffic volume in Pennsylvania were, of course, somewhat less than in Maine.

The discussion so far has related solely to data obtained from simple traffic counts on the turnpike and on other roads. The conclusions which can be drawn from this type of information are somewhat clouded by the fact that there is no differentiation between passenger car and truck traffic, or between

trips which could conveniently make use of the turnpike and those which are purely local. Relations of the kind which have been presented would be expected to vary widely in different areas according to the composition and characteristics of traffic in the area. In order to establish more basic relations, intensive traffic studies were made on several of the turnpikes. In these studies, drivers were interviewed at stations on roads parallel to the turnpike route both before and after the opening of the turnpike, and at all turnpike interchanges after its opening. Questions were asked concerning trip origins and destinations, trip purposes and other matters pertinent to the study.

Such an origin and destination study was made for the Maine Turnpike and for the eastern extension of the Pennsylvania Turnpike. In both cases the field survey was made by the State highway department as a part of our regular cooperative highway planning survey program and the analysis was made by the Bureau of Public Roads. The Maine study was described in detail by Mr. J. C. Carpenter, in a paper presented at the Highway Research Board and printed in the *Proceedings* for 1953. The Pennsylvania study will be similarly described by Mr. Daniel O'Flaherty, in an early issue of *PUBLIC ROADS*, the official magazine of the Bureau of Public Roads. I shall not, therefore, describe the survey methods here except to say that roadside interviews were conducted at selected points on weekdays, Saturdays, and Sundays, mostly during the summer months, both before and after the opening of the turnpike. In the case of Maine, interviews were made in August and October of 1947, before the turnpike was opened, and in August and October of 1948 and in August of 1950 after it was opened. In the case of Pennsylvania the interviews were made in the summer of 1950 before and in the summer of 1952 after the turnpike was opened.

Fig. 6 shows the location of the Maine Turnpike and U.S. 1, which parallels it. The length of the turnpike is 44.9 miles, and that of U.S. 1 between turnpike termini is 44.2 miles. This somewhat longer length for the turnpike is due to the right-angle turn near the northern end. This turn adversely affects the usage of the turnpike by trips between Portland and points along the shore, as will be seen from the analysis to follow.

This figure also shows the location of the interview stations and the automatic recorder on U.S. 1. There were 3 interview stations on U.S. 1, and in addition interviews were made on all turnpike off ramps.

For purposes of studying the behavior of trips of different lengths through the turnpike area, this area is divided into three sections, A, B, and C as shown in Fig. 6, each section containing an interview station on U.S. 1. Sections begin and end at turnpike interchanges although there are two additional interchanges within section B at Kennebunk and Biddeford. With the exception of a few short trips between these interchanges within section B, all of the trips which could be conveniently served by the turnpike would have to cross entirely through one or more of the three sections.

Fig. 7 shows, for August 1950, the average daily number and percentage distribution of passenger car trips between the turnpike and U.S. 1 extending through different lengths of the turnpike corridor as measured by the 3 sections A, B, and C, which are shown near the center of the chart. The widths of the bands are proportional to the number of trips and figures in parentheses indicate the percentage distribution between the turnpike and U.S. 1. Trips using the turnpike are shown above the center of the chart and those using U.S. 1 are shown below the center. The first band above the center shows the through trips using the turnpike; that is, trips with one

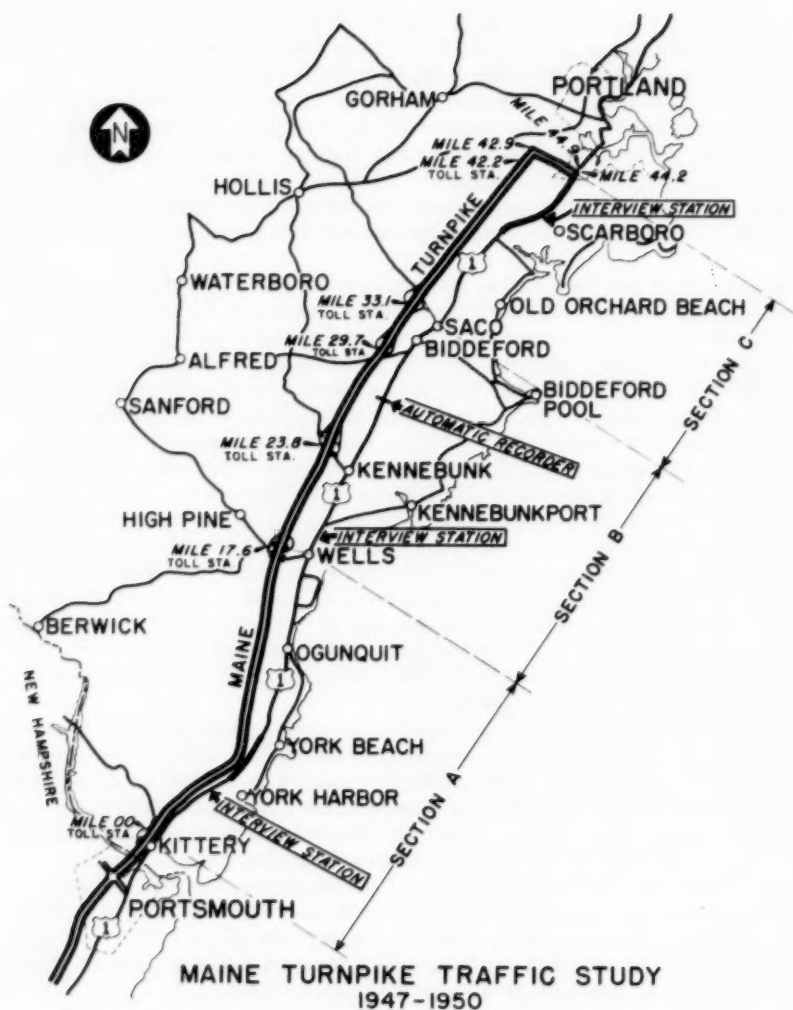


FIGURE 6

terminal south of the south end of the turnpike and the other terminal north of the north end of the turnpike, and the first band below the center with similar shading shows trips of corresponding length through the area which used U.S. 1. The distribution of these through trips is 75 percent on the turnpike and 25 percent on U.S. 1.

The next band above the center shows the turnpike trips with one terminal south of the south end of the turnpike and the other terminal in section C, passing through sections A and B, and the corresponding band below the center shows the number of corresponding trips using U.S. 1. Of the trips in this category, 55 percent used the turnpike. The third bands above and below the center indicate corresponding trips with one terminal north of the

MAINE TURNPIKE TRAFFIC STUDY
 DISTRIBUTION OF PASSENGER CAR TRIPS BETWEEN TURNPIKE AND U S 1
 AVERAGE DAILY - AUGUST 1950

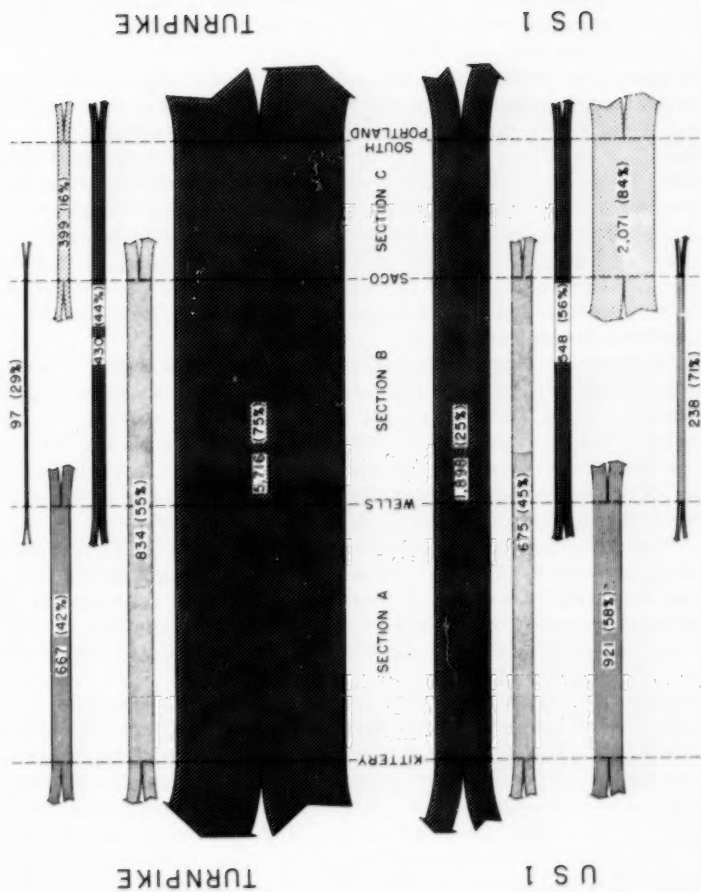


FIGURE 7

north end of the turnpike and the other in section A, passing through sections B and C. The effect of the rightangle turn near the northern end of the turnpike begins to be apparent here, for the percentage use of the turnpike is somewhat smaller, being 44 percent.

The next two pairs of bands, one pair above and the other below the center show the trips with one terminal in the middle section and the other terminal beyond one end of the turnpike passing through end section A or C. Of the trips between section B and Kittery and points south, 42 percent used the turnpike compared to only 16 percent of the trips between section B and South Portland and points north. This shows the extent to which the turnpike usage by these comparatively short trips in and out of Portland is reduced because of the unfavorable turnpike alinement.

The outermost bands above and below the center line represent trips with both origin and destination within the turnpike area passing through section B only. Twenty-nine percent of these trips used the turnpike.

Thus, it is seen that the length of that part of the trip which might use the turnpike has an important bearing on the percentage distribution, the turnpike usage for those trips traversing the entire 45 mile length being 75 percent, for those traversing two of the three sections being from 44 to 55 percent, and for those traversing only one section being from 16 to 42 percent. Of course, there were a large number of short trips on U.S. 1 not shown on the chart, which did not pass through a full section. These did not use the turnpike because they could not do so to advantage.

Fig. 8 shows the growth (including generation) of passenger car trips extending all the way through the turnpike area, of those extending through two sections, and of those extending through only one section, for the three summers in which origin and destination studies were made. The number of trips on U.S. 1 in August 1947 is taken as 100 percent in each case, and the number of trips through the corridor in August 1948 and in August 1950, are shown, by the heights of the bars, as percentages of the number of trips in 1947. This distribution of trips between the turnpike and U.S. 1 in 1948 and 1950 are shown by the figures within the bars. The percentage distribution between the turnpike and U.S. 1 remained reasonably constant for trips in all three categories, from 1948 to 1950. Note especially that the through trips increased by a considerably higher percentage than trips passing only part way through the area.

The question arises as to whether the total length of the trip, including that portion of it which is beyond the turnpike area, affects the percentage of turnpike usage. Fig. 9 shows, for August 1950, the percentage use of the turnpike for through passenger car trips in different ranges of total length from origin to destination. The widths of the bars are proportional to the number of trips within the length range. The thin bar to the left for trips from 50 to 99 miles is composed largely of trips between Portsmouth and Portland. Only 53 percent of these used the turnpike. The wide bar for lengths from 100 to 199 miles includes the trips between Boston and Portland. Seventy-five percent of the trips in this length range use the turnpike. The third bar for trips from 200 to 299 miles include the trips between Boston and Bar Harbor and Boston and Bangor. Eighty percent of the trips in this group made use of the turnpike. For trips of longer length, the turnpike usage was about the same as it was for the trips in the 100-to 199-mile group and we might conclude from this that the total length of the trip affects the turnpike usage up to a certain distance (say about 200 miles) and that beyond this the length of trip has little or no effect on turnpike usage.

MAINE TURNPIKE TRAFFIC STUDY

GROWTH IN NUMBER OF FULL LENGTH TRIPS, TRIPS THROUGH TWO SECTIONS AND TRIPS THROUGH ONE SECTION, FROM AUGUST 1947 TO AUGUST 1948 AND AUGUST 1950, AND PERCENTAGE DISTRIBUTION BETWEEN TURNPIKE AND U. S. 1

PASSENGER CARS - AVERAGE DAILY

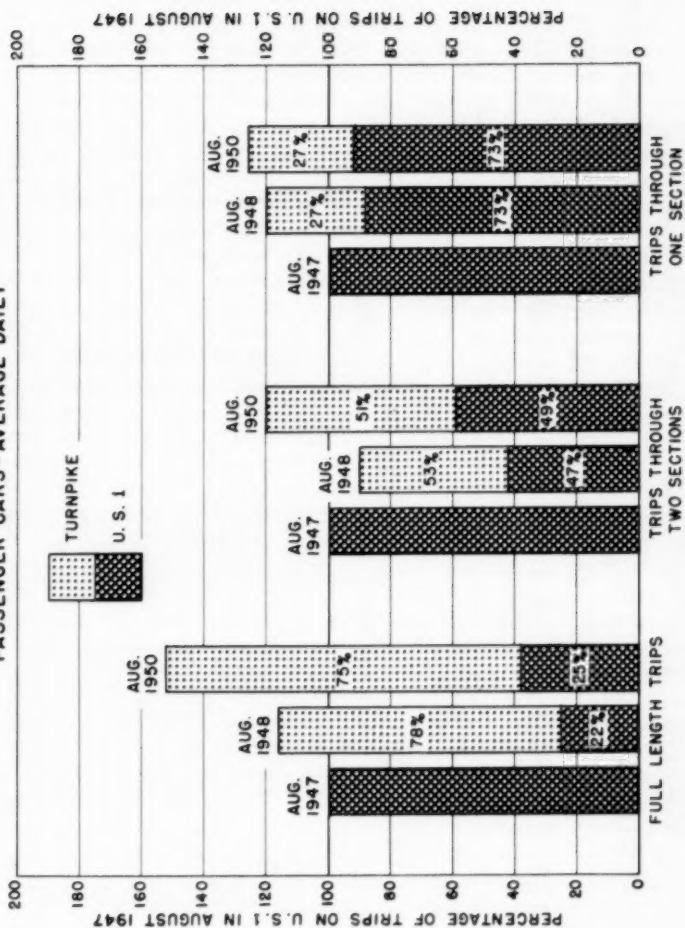


FIGURE 8

MAINE TURNPIKE TRAFFIC STUDY DISTRIBUTION OF THROUGH TRIPS IN THE CORRIDOR, BY PERCENT USE OF THE MAINE TURNPIKE AND BY TRIP LENGTH AUGUST 1950 AVERAGE DAILY PASSENGER CAR TRAFFIC

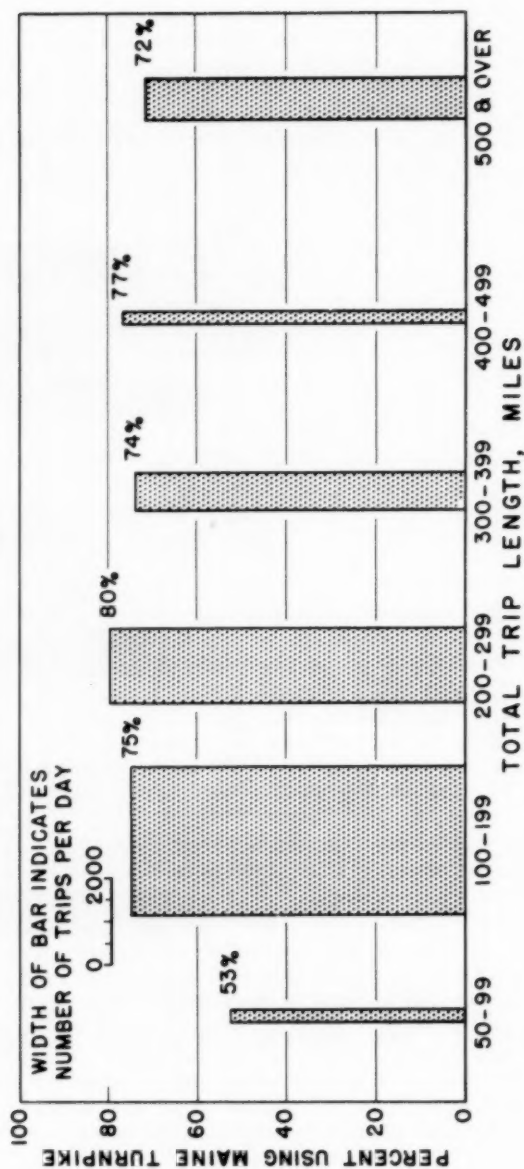


FIGURE 9

However, the location of Boston in relation to the turnpike may have some bearing in this case.

For trips passing only part way through the turnpike area, the percentage use of the turnpike by trucks was about the same as for passenger cars. The number of these short truck trips was small, however. In August 1948, the usage of the turnpike by trucks (particularly the heavy trucks) passing all of the way through the area was much lower proportionately than the usage by passenger cars. Between the survey in August 1948 and that in August 1950, however, there was a large increase in the percentage of through truck trips using the turnpike. Fig. 10 shows these relations for three groups of trucks: for very light panels and pickups, for other single-unit trucks and for combinations which are used principally by the large commercial haulers. The widths of the bars are proportional to the total number of trucks in each category passing through the corridor and the heights of the bars indicate the percentages using the turnpike. There was a decline in the total number of trucks in all categories passing through the corridor, as indicated by the fact that the 1950 bar is narrower than the 1948 bar in each case. However, for all three classes, a much higher percentage used the turnpike in August 1950 than in August 1948, so there was an actual increase in the number of trucks on the turnpike. The proportionate usage for the light panels and pickups and for other single-unit trucks passing through the corridor in August 1950 was not so far below the passenger car usage, but the usage by the combinations was considerably lower, being only 33 percent of the total number passing through the corridor in August 1950, compared to 75 percent for through passenger car trips.

The situation with respect to the eastern extension of the Pennsylvania Turnpike is quite different from that of the Maine Turnpike not only because it is considerably longer in itself, but also because it connects with the old section forming a continuous turnpike (including the western extension which was opened in 1951), of 327 miles reaching from near Philadelphia to the Ohio line, as can be seen from the mileage log at the bottom of Fig. 11. The eastern extension, which was opened in November 1950, extends from Valley Forge to Carlisle, a distance of about 100 miles. It was along this extension the interviews were taken before and after the project was completed. Fig. 11 shows the location of the interview and automatic recorder stations, and the outlines of the zones used for grouping origins and destinations. The analysis of this study has not yet been completed but some of the results with respect to the trips having either origin or destination in Philadelphia can be presented. These trips constitute about 40 percent of the traffic at the eastern end of the turnpike.

Shown on the map designated Fig. 12 are areas marked by different types of shading, so drawn that the usage of the turnpike by truck trips between each area and Philadelphia falls within a percentage range as specified in the legend. The area where the usage was less than 20 percent extends from the Philadelphia end of the turnpike westward for about 40 miles, and farther south, almost 100 miles westward along U.S. 30. The percentage of the turnpike use for truck trips between this area and Philadelphia was very low in most cases, being 5 percent for Reading, 5 percent for Lancaster and only 1 percent for York. The area to and from which 20 to 40 percent of the Philadelphia trips used the turnpike includes Harrisburg and extends westward to the north along the route of U.S. 22 and 422 to a point north of Pittsburgh. South of the turnpike, from Gettysburg westward, Philadelphia trips with origin and destination close to U.S. 30 used the turnpike to a

MAINE TURNPIKE TRAFFIC STUDY

PERCENTAGE OF THROUGH TRIPS BY TRUCKS
OF DIFFERENT CLASSES USING TURNPIKE
AVERAGE WEEKDAY

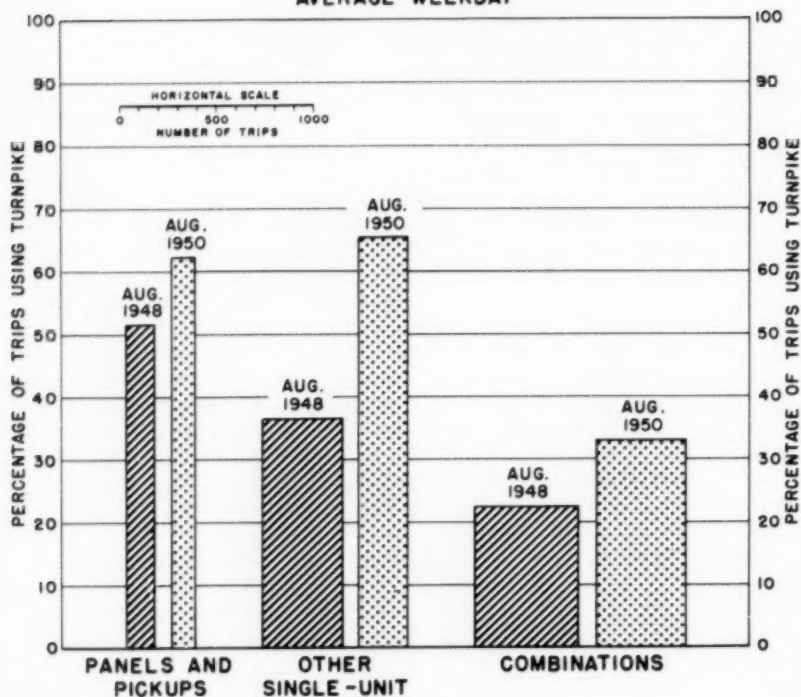


FIGURE 10

PENNSYLVANIA TURNPIKE TRAFFIC STUDY

ZONES AND INTERVIEW STATIONS

SUMMER OF 1952

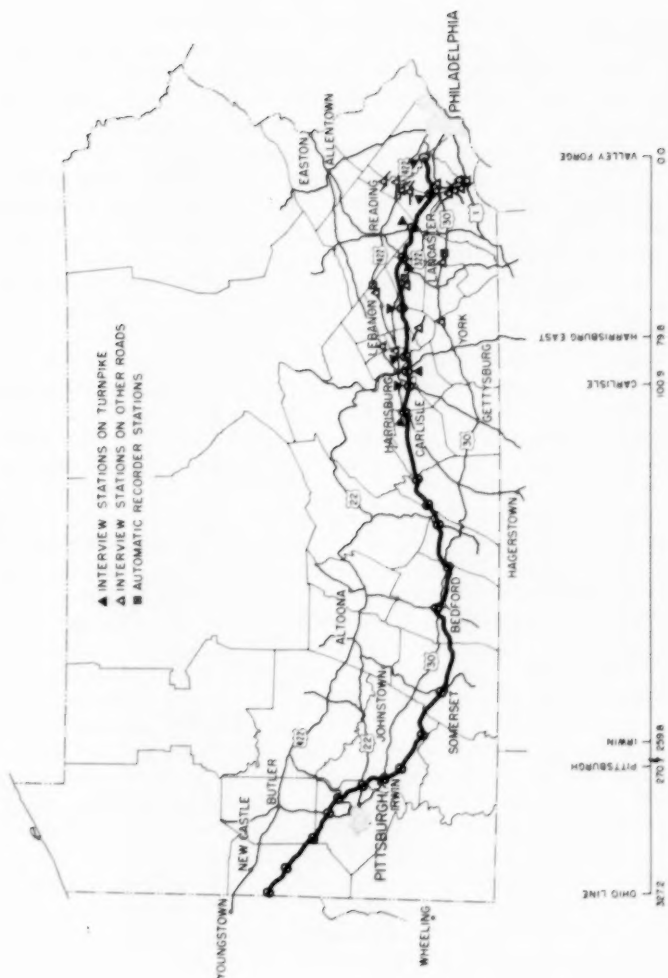


FIGURE II

PENNSYLVANIA TURNPIKE TRAFFIC STUDY

TRUCK TRIPS BETWEEN PHILADELPHIA
AND AREAS ALONG TURNPIKE

PERCENTAGE USING TURNPIKE - AVERAGE WEEKDAY, SUMMER OF 1952

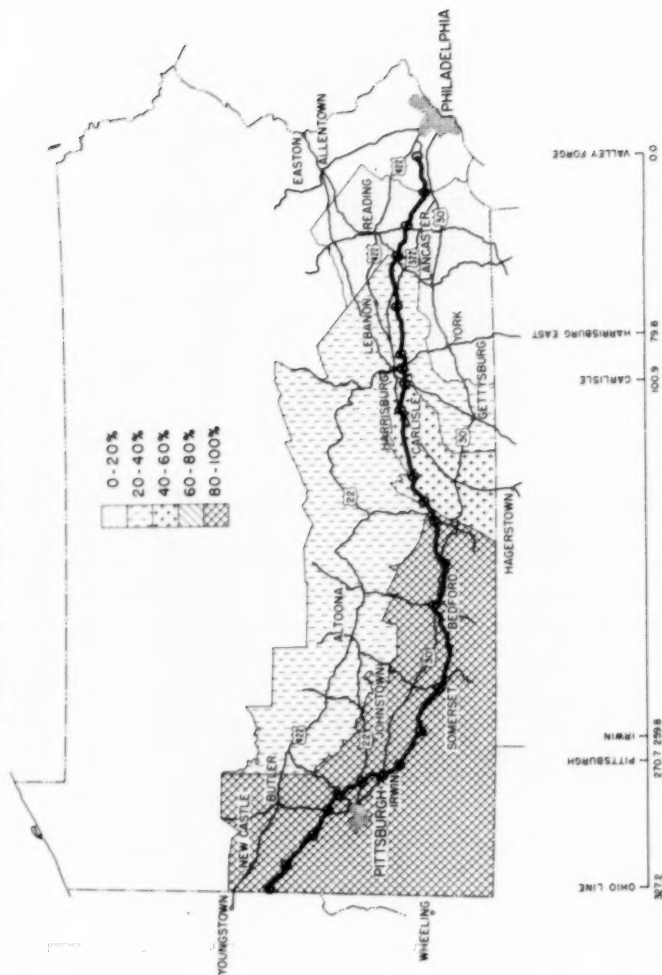


FIGURE 12

rapidly increasing degree. The 80 to 100 percent area is reached at a point about half way between Carlisle and Bedford. Beyond that point over 80 percent of the truck trips between Philadelphia and the area served by U.S. 30 as the principal free route used the turnpike. It will be noted that the greater usage of the turnpike by trucks for the longer trips is just the reverse of what was found in Maine. There, it was the trips passing through the turnpike area for only part of its length, that used the turnpike to a much greater extent than those passing all of the way through.

The high usage of the Pennsylvania Turnpike by trucks is unique in turnpike experience and is due principally to the very steep grades and sharp curves on U.S. 30. For example, the total rise and fall on U.S. 30 for 150 miles westward from Carlisle is 26,257 feet compared to 11,327 feet on the turnpike. The average time saving for trucks using the turnpike between Pittsburgh and Philadelphia is almost three hours. These advantages are not likely to be duplicated on many other toll roads.

Fig. 13 shows the relative turnpike usage by passenger car trips in and out of Philadelphia in the same manner as the information is given for truck trips in Fig. 11. As in the case of truck trips, over 80 percent of the passenger car trips with origin and destination in the area west of a point midway between Carlisle and Bedford made use of the turnpike. In this case, however, this area extends upward across Route 422 just west of Johnstown. Also, there is another area of 80- to 100- percent usage extending westward from Harrisburg and including Carlisle. Of the passenger car trips between Pittsburgh and Philadelphia, 89 percent used the turnpike. This compares with 72 percent of the passenger car trips between Boston and Portland, and 84 percent of those between Boston and Bar Harbor, using the Maine Turnpike in August 1950.

In the case of passenger cars, from 60 to 80 percent of the trips between Philadelphia and areas along U. S. 22 and U.S. 422 from Harrisburg to Johnstown used the turnpike contrasted with 20- to 40-percent usage by trucks. Between Harrisburg and Philadelphia, 76 percent of the passenger cars used the turnpike compared to 36 percent of the trucks. There is little usage of the turnpike by either passenger cars or trucks where the usable length toward the Philadelphia end is less than about 40 miles. This is almost equal to the full length of the Maine Turnpike, where there is a 75-percent usage by through passenger-car trips.

Fig. 14 shows the growth in the number of passenger car trips using all routes between Philadelphia and the different areas shown in Fig. 13 from 1950, before the turnpike was opened, to 1952 after it was opened. This is for summer weekday trips whereas the trips shown in the Maine charts were for average daily summer trips including Saturdays and Sundays. The hundred percent line on the chart represents the number of trips between the different areas and Philadelphia the summer before the turnpike was opened. For the area of less than 20 percent turnpike usage there was a 3-percent decline in the number of trips from 1950 to 1952. For the area of 20 to 40 percent turnpike usage there was a 9-percent increase; for the 40- to 60-percent area, an 11-percent increase; for the 60- to 80-percent area, a 37-percent increase; and for the 80- to 100-percent area, a 55-percent increase. Thus, the higher the percentage use of the turnpike by trips to and from Philadelphia for any area the greater was the growth in the number of these trips by all routes after the turnpike was opened, indicating definitely that the increase was caused by the existence of the turnpike.

PENNSYLVANIA TURNPIKE TRAFFIC STUDY

PASSENGER CAR TRIPS BETWEEN PHILADELPHIA
AND AREAS ALONG TURNPIKE

PERCENTAGE USING TURNPIKE - AVERAGE WEEKDAY, SUMMER OF 1952

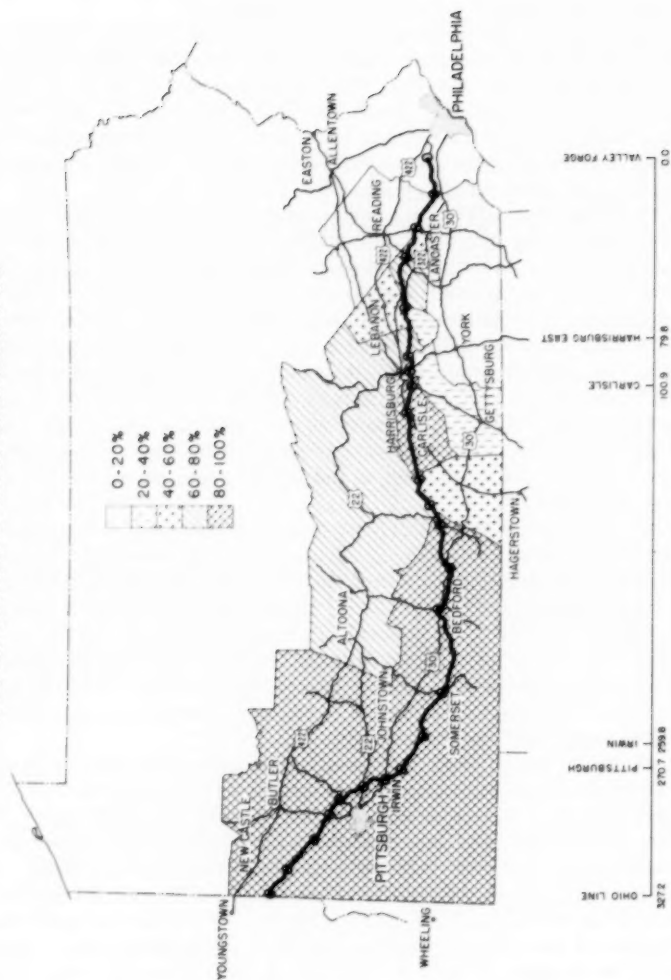


FIGURE 13

PENNSYLVANIA TURNPIKE TRAFFIC STUDY NUMBER OF TRIPS PER DAY BETWEEN PHILADELPHIA AND AREAS ALONG TURNPIKE IN 1952 COMPARED TO 1950 PASSENGER CARS SUMMER WEEKDAY

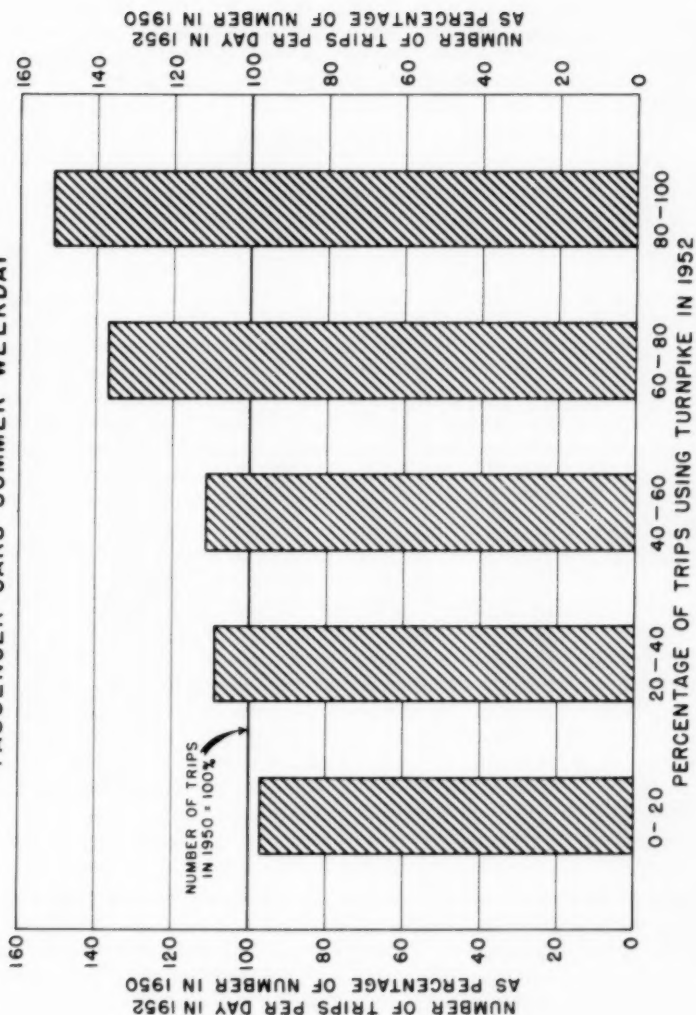


FIGURE 14

Fig. 15 shows the percentage increase in the number of trips between Philadelphia and certain cities along the turnpike route after the turnpike was opened. For Reading, where the percentage use of the turnpike was 14-per-cent as indicated by the figure below the bar, there was only a 2-percent

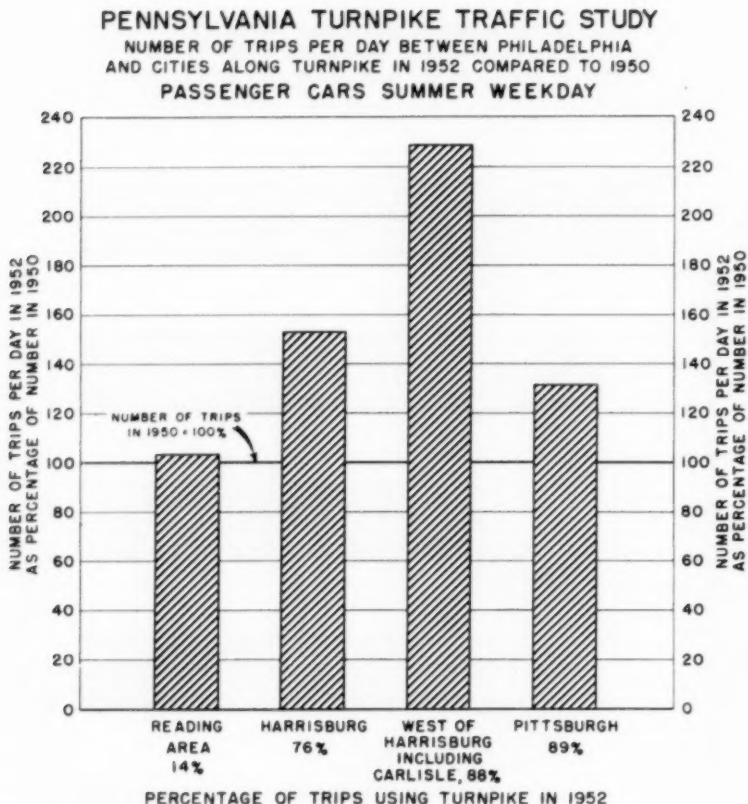


FIGURE 15

increase in the number of Philadelphia trips as indicated by the height of the bar; for Harrisburg there was a 53-percent increase in the number of trips to and from Philadelphia. For Carlisle and the intervening area west of Harrisburg, the increase in the number of Philadelphia trips was 129-percent. This area is at the western end of the eastern extension of the Pennsylvania Turnpike and would, therefore, benefit more, proportionately, by the opening of this extension than any other area. Trips between Philadelphia and Pittsburgh have benefited by the existence of the original section of the Pennsylvania Turnpike from Irwin to Carlisle for many years and the opening of the eastern extension was not so important, relatively, for these trips as it was for the trips between Carlisle and Philadelphia. For this reason, the percentage increase in the number of trips from Pittsburgh to

Philadelphia, after the opening of the eastern extension of the turnpike, was only 31 percent.

The question has often been raised as to whether the purpose of trips has any effect on turnpike usage and it has sometimes been assumed that trips for work or business would use the turnpike to a greater extent than those for social, recreational and other purposes. The results of the study of the eastern extension of the Pennsylvania Turnpike seem to support such an assumption.

Fig. 16 shows the percentage use by work or business trips and by other trips between Philadelphia and the 0- to 20-percent-usage area which was shown in Fig. 12. The widths of the bars are proportional to the number of trips in each category. For this area, which is relatively close to Philadelphia, 8 percent of the business trips and 7 percent of the trips made for other purposes made use of the turnpike.

Fig. 17 shows, similarly, the relative usage of the turnpike by work and business trips and trips for other purposes for trips between Philadelphia and other areas. Because of the smallness of the sample when broken down by trip purpose, it was necessary to combine the 20 to 40 and the 40- to 60-percent areas in this chart. Trips between Philadelphia and points in Ohio are also shown. In every case the trips for work or business used the turnpike to a somewhat greater extent than those for other purposes.

Most of the trips for purposes other than work or business (with origin or destination in Philadelphia) were for social and recreational purposes and very few of them were vacation trips in the sense that the term is usually used. A study of the trips using the Pennsylvania Turnpike destined for the southern New Jersey shore resorts, when completed, should produce some interesting information concerning vacation travel. The study of the Maine Turnpike, where the vacation trips are much larger in number than those for any other purpose, showed that these trips used the turnpike to a somewhat greater extent than the work or business trips.

Fig. 18 gives this information for through trips on an average day in August 1950. From the width of the bars it can be seen that the vacation trips exceeded those for all other purposes combined. The heights of the bars indicate that vacation trips used the turnpike to a somewhat greater extent than those for work or business, and to a much greater extent than those for social and recreational purposes. The higher turnpike usage by trips for other purpose, as shown by the thin bar at the right, is not considered significant because of the smallness of the sample.

To determine whether the higher turnpike usage by vacation trips was actually due to trip purpose, or was because of the location of the origins and destinations of these trips, comparisons by purpose were made for trips between specific origins and destinations. The only specific trip movements which were sufficiently large to give a stable sample by purpose were those between Boston and Portland, Boston and Bangor and Boston and Bar Harbor. Fig. 19 shows the percentage use of the turnpike for these trips by trip purpose. In all three cases, the percentage of turnpike use by vacation trips was greatest, that by work or business trips was next, and that by social or recreational trips was lowest, indicating that the purpose of trip, in itself, has a bearing on the extent of turnpike use. However, we cannot conclude that these relations are typical, until they have been confirmed by other studies.

Though the correlation is far from perfect, our studies to date indicate that the best measure of relative turnpike usage is the comparative trip

PENNSYLVANIA TURNPIKE TRAFFIC STUDY PERCENTAGE OF TRIPS BETWEEN PHILADELPHIA AND O-20% TURNPIKE USAGE AREA USING TURNPIKE, BY TRIP PURPOSE SUMMER WEEKDAY - 1952

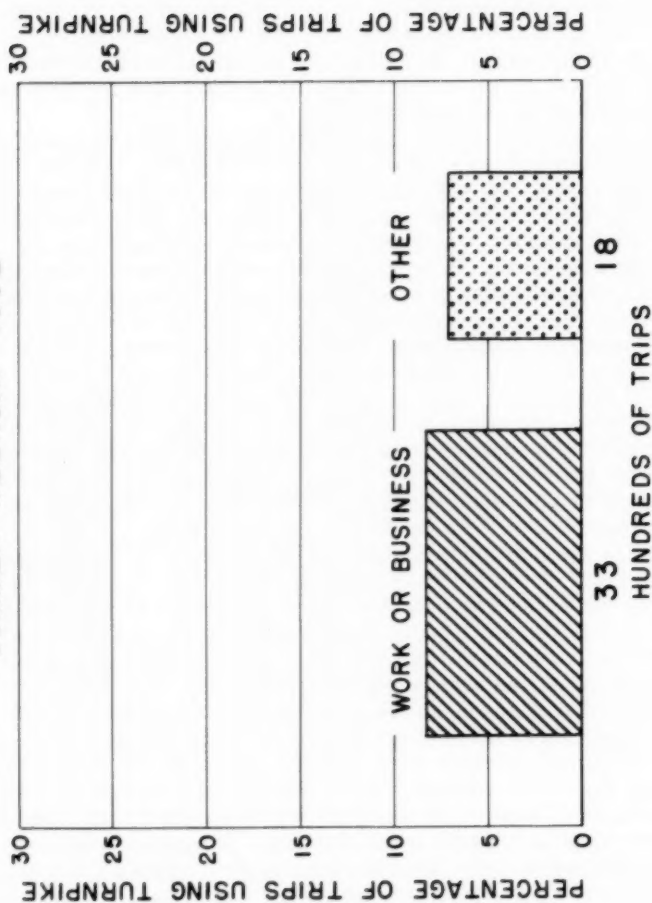


FIGURE 16

PENNSYLVANIA TURNPIKE TRAFFIC STUDY

PERCENTAGE OF TRIPS BETWEEN PHILADELPHIA
AND OTHER AREAS USING TURNPIKE, BY TRIP PURPOSE
SUMMER WEEKDAY-1952

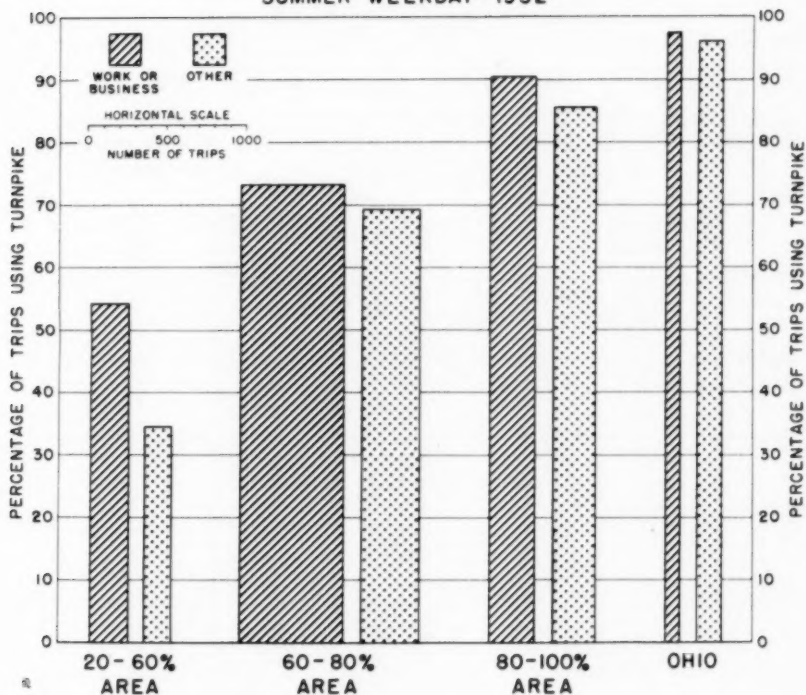


FIGURE 17

time by way of the turnpike and by other roads. This can be expressed either as a time ratio or as the number of minutes saved or lost in making use of the turnpike. Such curves are being constructed from the results of the study of the eastern extension of the Pennsylvania Turnpike and Mr. O'Flaherty will present them in his article in *PUBLIC ROADS* previously referred to. Comparing preliminary drafts of these curves with such information as is available concerning the usage of free controlled access facilities in relation to time ratio or time saved, it would appear that where the time saving is large the proportion of the trips using the high type facility would be approximately as high for a toll facility as for a free facility, but that where the time saving is small the proportionate usage of a toll road would be much lower than that of a free road of comparable characteristics. This conclusion is tentative only, and any curves relating percentage usage with time saving drawn from the data developed in the study of the eastern extension of the Pennsylvania Turnpike alone would have to be confirmed by data developed for different situations before they could be accepted as being generally applicable.

MAINE TURNPIKE TRAFFIC STUDY

PERCENTAGE OF THROUGH PASSENGER CAR TRIPS
USING TURNPIKE, BY TRIP PURPOSE

AVERAGE DAILY-AUGUST 1950

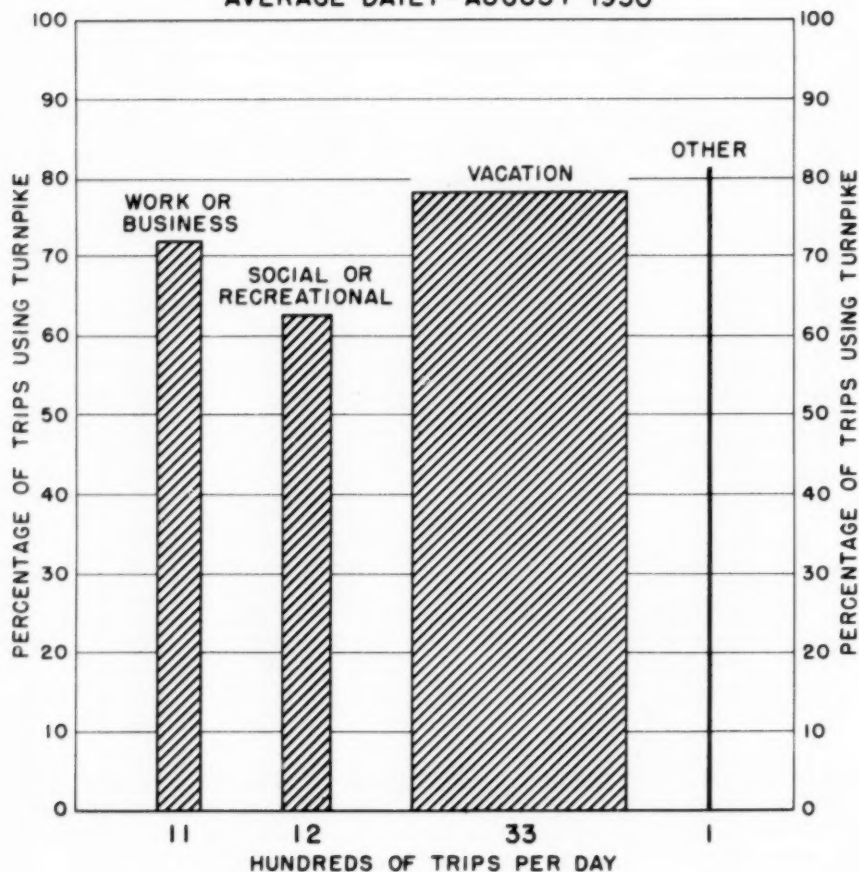


FIGURE 18

Studies similar to those made in Maine and on the eastern extension of the Pennsylvania Turnpike are being made on the western extension of the Pennsylvania Turnpike and on the Ohio Turnpike. Also, a similar study is being made on the New Jersey Turnpike, which is being analyzed by the State. When these are completed our knowledge concerning the diversion, generation, and growth of turnpike traffic will be greatly increased.

MAINE TURNPIKE TRAFFIC STUDY

PERCENTAGE OF PASSENGER CAR TRIPS BETWEEN BOSTON
AND POINTS NORTH OF TURNPIKE USING TURNPIKE, BY TRIP PURPOSE
AVERAGE DAILY-AUGUST 1950

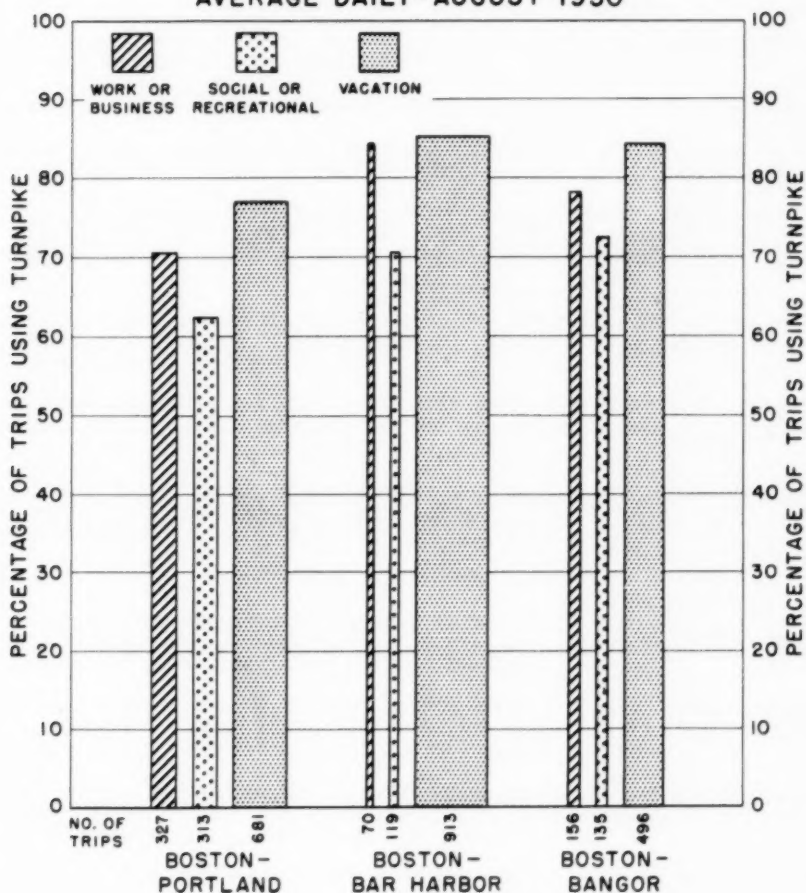


FIGURE 19

PROCEEDINGS-SEPARATES

The technical papers published in the past year are presented below. Technical-division sponsorship is indicated by an abbreviation at the end of each Separate Number, the symbols referring to: Air Transport (AT), City Planning (CP), Construction (CO), Engineering Mechanics (EM), Highway (HW), Hydraulics (HY), Irrigation and Drainage (IR), Power (PO), Sanitary Engineering (SA), Soil Mechanics and Foundations (SM), Structural (ST), Surveying and Mapping (SU), and Waterways (WW) divisions. For titles and order coupons, refer to the appropriate issue of "Civil Engineering" or write for a cumulative price list.

VOLUME 80 (1954)

JUNE: 444(SM)^e, 445(SM)^e, 446(ST)^e, 447(ST)^e, 448(ST)^e, 449(ST)^e, 450(ST)^e, 451(ST)^e, 452(SA)^e, 453(SA)^e, 454(SA)^e, 455(SA)^e, 456(SM)^e.

JULY: 457(AT), 458(AT), 459(AT)^c, 460(IR), 461(IR), 462(IR), 463(IR)^c, 464(PO), 465(PO)^c.

AUGUST: 466(HY), 467(HY), 468(ST), 469(ST), 470(ST), 471(SA), 472(SA), 473(SA), 474(SA), 475(SM), 476(SM), 477(SM), 478(SM)^c, 479(HY)^c, 480(ST)^c, 481(SA)^c, 482(HY), 483(HY).

SEPTEMBER: 484(ST), 485(ST), 486(ST), 487(CP)^c, 488(ST)^c, 489(HY), 490(HY), 491(HY)^c, 492(SA), 493(SA), 494(SA), 495(SA), 496(SA), 497(SA), 498(SA), 499(HW), 500(HW), 501(HW)^c, 502(WW), 503(WW), 504(WW)^c, 505(CO), 506(CO)^c, 507(CP), 508(CP), 509(CP), 510(CP), 511(CP).

OCTOBER: 512(SM), 513(SM), 514(SM), 515(SM), 516(SM), 517(PO), 518(SM)^c, 519(IR), 520(IR), 521(IR), 522(IR)^c, 523(AT)^c, 524(SU), 525(SU)^c, 526(EM), 527(EM), 528(EM), 529(EM), 530(EM)^c, 531(EM), 532(EM)^c, 533(PO).

NOVEMBER: 534(HY), 535(HY), 536(HY), 537(HY), 538(HY)^c, 539(ST), 540(ST), 541(ST), 542(ST), 543(ST), 544(ST), 545(SA), 546(SA), 547(SA), 548(SM), 549(SM), 550(SM), 551(SM), 552(SA), 553(SM)^c, 554(SA), 555(SA), 556(SA), 557(SA).

DECEMBER: 558(ST), 559(ST), 560(ST), 561(ST), 562(ST), 563(ST)^c, 564(HY), 565(HY), 566(HY), 567(HY), 568(HY)^c, 569(SM), 570(SM), 571(SM), 572(SM)^c, 573(SM)^c, 574(SU), 575(SU), 576(SU), 577(SU), 578(HY), 579(ST), 580(SU), 581(SU), 582(Index).

VOLUME 81 (1955)

JANUARY: 583(ST), 584(ST), 585(ST), 586(ST), 587(ST), 588(ST), 589(ST)^c, 590(SA), 591(SA), 592(SA), 593(SA), 594(SA), 595(SA)^c, 596(HW), 597(HW), 598(HW)^c, 599(CP), 600(CP), 601(CP), 602(CP), 603(CP), 604(EM), 605(EM), 606(EM)^c, 607(EM).

FEBRUARY: 608(WW), 609(WW), 610(WW), 611(WW), 612(WW), 613(WW), 614(WW), 615(WW), 616(WW), 617(IR), 618(IR), 619(IR), 620(IR), 621(IR)^c, 622(IR), 623(IR), 624(HY)^c, 625(HY), 626(HY), 627(HY), 628(HY), 629(HY), 630(HY), 631(HY), 632(CO), 633(CO).

MARCH: 634(PO), 635(PO), 636(PO), 637(PO), 638(PO), 639(PO), 640(PO), 641(PO)^c, 642(SA), 643(SA), 644(SA), 645(SA), 646(SA), 647(SA)^c, 648(ST), 649(ST), 650(ST), 651(ST), 652(ST), 653(ST), 654(ST)^c, 655(SA), 656(SM)^c, 657(SM)^c, 658(SM)^c.

APRIL: 659(ST), 660(ST), 661(ST)^c, 662(ST), 663(ST), 664(ST)^c, 665(HY)^c, 666(HY), 667(HY), 668(HY), 669(HY), 670(EM), 671(EM), 672(EM), 673(EM), 674(EM), 675(EM), 676(EM), 677(EM), 678(HY).

MAY: 679(ST), 680(ST), 681(ST), 682(ST)^c, 683(ST), 684(ST), 685(SA), 686(SA), 687(SA), 688(SA), 689(SA)^c, 690(EM), 691(EM), 692(EM), 693(EM), 694(EM), 695(EM), 696(PO), 697(PO), 698(SA), 699(PO)^c, 700(PO), 701(ST)^c.

JUNE: 702(HW), 703(HW), 704(HW)^c, 705(IR), 706(IR), 707(IR), 708(IR), 709(HY)^c, 710(CP), 711(CP), 712(CP), 713(CP)^c, 714(HY), 715(HY), 716(HY), 717(HY), 718(SM)^c, 719(HY)^c, 720(AT), 721(AT), 722(SU), 723(WW), 724(WW), 725(WW), 726(WW)^c, 727(WW), 728(IR), 729(IR), 730(SU)^c, 731(SU).

c. Discussion of several papers, grouped by Divisions.

e. Presented at the Atlantic City (N.J.) Convention in June, 1954.

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